Chapter 1. SUMMARY

1.1 Introduction

The waters surrounding California's Channel Islands represent a unique and diverse assemblage of habitats and species. In the area between Santa Barbara Island in the south and San Miguel Island in the northwest two oceanic provinces, the colder Oregonian province in the north and the warmer Californian province in the south, converge and mix. Each province is defined by oceanic conditions and species assemblages which in turn are parts of distinct biogeographic regions. The mixing of these two provinces in the vicinity of the Channel Islands creates a transition zone within the island chain. In addition, upwelling and ocean currents in the area support a variety of species in a nutrient rich environment.

This rich oceanic and island ecosystem is recognized nationally and internationally and afforded protection at all levels of government. Additionally, many species are important to both commercial and recreational user groups and effect local, State and international economies. In order to insure long-term protection and to provide for sustainable use of this ecosystem and the associated species and habitats the proposed project establishes a network of Marine Protected Areas where commercial and recreational take is prohibited or limited. This document describes the proposed project and alternatives as well as their potential effects on the environment. The project area focuses on State waters within the National Oceanic and Atmospheric Administration's (NOAA) Channel Islands National Marine Sanctuary (Sanctuary).

1.2 Location and General Characteristics of the Project Area

The proposed project will affect the area within NOAA's Channel Islands National Marine Sanctuary. The Sanctuary encompasses 1,252 square nautical miles from the mean high tide line to 6 nautical miles offshore the northern Channel Islands (Anacapa, Santa Cruz, Santa Rosa and San Miguel Islands) and Santa Barbara Island. For the purposes of comparative size analysis **in the Draft Environmental Document**, the project area was considered to be **a "planning unit"** area encompassing 1500 square miles (1133 square nautical miles) which could be easily described in a Geographic Information System database. **In order to more specifically and accurately represent reserve size, total square nautical miles is used in this Final Environmental Document. This does not change the percentage areas or comparative analyses nor does it alter the environmental impact analysis or Department's conclusions as to the potential impacts of the proposed prosed project.** State waters within the Sanctuary encompass ~~592~~ **683** square nautical miles from the mean high tide line to three nautical miles offshore. The four northern islands parallel the east west trend of the coast and their closest points to the mainland coast vary between 13 and 25 miles offshore. Santa Barbara Island lies about 40 miles south of Point Mugu, California (Figure 1-1).

The Sanctuary and project area are a subset of the larger ecosystem of the Southern California Bight, an area bounded by Point Conception in the north and Punta Banda, Mexico in the south (Daily et al. 1993; Reisch et al. 1993). Point Conception is the southern-most major upwelling center on the west coast of the United States, and marks a transition zone between cool surface waters to the north and warm waters to the south. The oceanic currents and upwelling effects, with their varying water temperatures, create at least three broad climatic/habitat zones in the Santa Barbara Channel and surrounding region (Figure 1-1). The proposed project is intended to address concerns within this unique region brought forward during public processes.

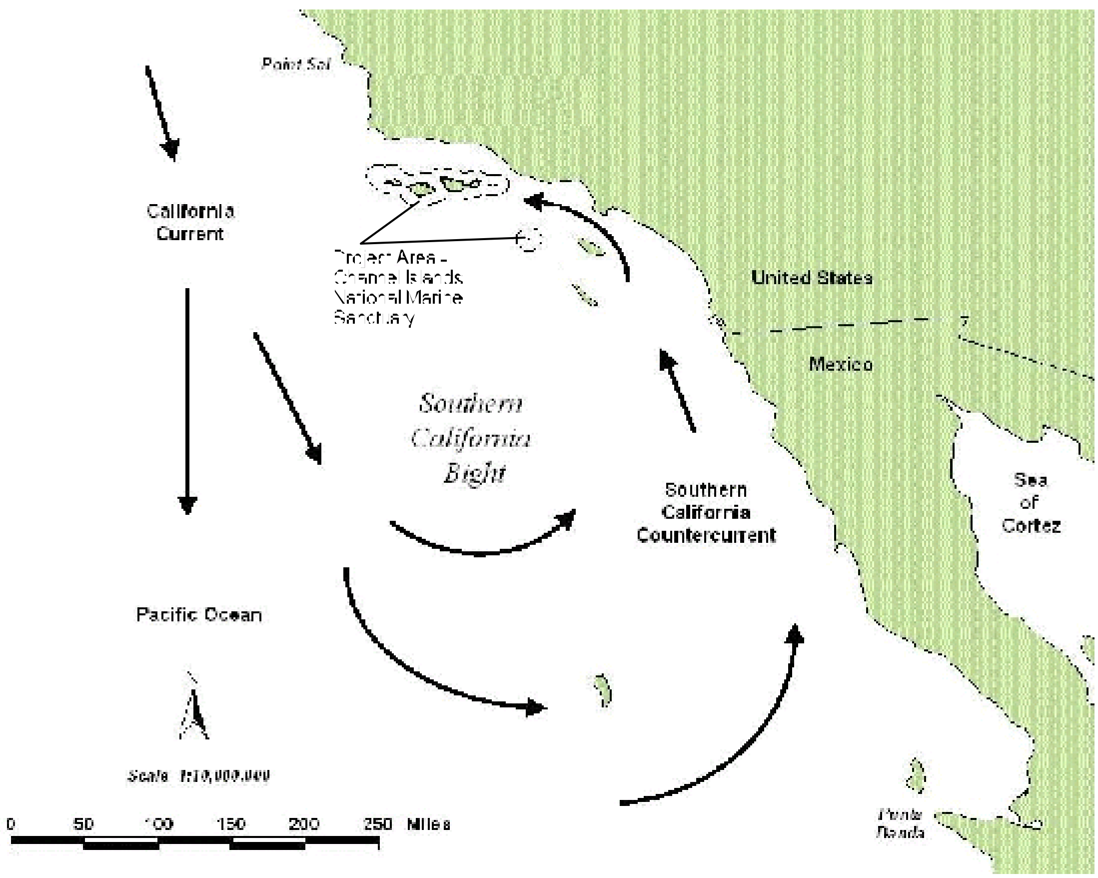

Figure 1-1. Southern California Bight and the Project Area.

San Miguel Island and parts of Santa Rosa Island are bathed by the cooler waters of the California current and are within the cool Oregonian biogeographic province. The warm waters of the California Countercurrent dominate the Santa Barbara Channel and Anacapa Island. These areas belong to the Californian biogeographic province. Santa

Barbara Island, Eastern Santa Rosa Island, and Santa Cruz Island occupy a transition zone between the cold and warm water provinces, and are generally considered a third biogeographic region.

1.3 Project Objectives

In 1998, the California Fish and Game Commission received a recommendation to create marine reserves, or no-take zones, around the northern Channel Islands. This recommendation suggested closing 20 percent of the shoreline outward to 1 nautical mile to all fishing. The recommendation led to more than one year of public discussion of the issue in the Commission forum. In response to the proposal and the need for an open constituent based process, the Channel Islands National Marine Sanctuary (Sanctuary) and the California Department of Fish and Game (Department) developed a joint Federal and State partnership to consider the establishment of marine reserves in the Sanctuary. The Commission endorsed this process at their March 4, 1999 meeting.

The Channel Islands National Marine Sanctuary Advisory Council (SAC), an advisory body to the Sanctuary Manager, created a stakeholder based community group called the Marine Reserves Working Group (MRWG) in July, 1999 (Appendix 3). This constituent panel was comprised of 17 members representing State and Federal agencies, conservation interests, consumptive recreational and commercial groups, the public at large, and the California Sea Grant program. The MRWG met 24 times between July 1999 and June 2001 to discuss issues surrounding the potential establishment of new MPAs and try to come to consensus on a recommendation on marine reserves at the Channel Islands.

While the MRWG did not reach consensus on a specific recommendation for the spatial placement of Marine Protected Areas, they did agree on a Mission Statement, Problem Statement, goals and objectives. The proposed project was created as a response to the consensus based Problem Statement:

> The urbanization of southern California has significantly increased the number of people visiting the coastal zone and using its resources. This has increased human demands on the ocean, including commercial and recreational fishing, as well as wildlife viewing and other activities. A burgeoning coastal population has also greatly increased the use of our coastal waters as receiving areas for human, industrial, and agricultural wastes. In addition, new technologies have increased the efficiency, effectiveness, and yield of sport and commercial fisheries. Concurrently there have been wide scale natural phenomena such as El Niño weather patterns, oceanographic regime shifts, and dramatic fluctuations in pinniped populations.

> In recognizing the scarcity of many marine organisms relative to past abundance, any of the above factors could play a role. Everyone concerned desires to better understand the effects of the individual factors and their interactions, to reverse or stop trends of resource decline, and to restore the integrity and resilience of impaired ecosystems.
>
> To protect, maintain, restore, and enhance living marine resources, it is necessary to develop new management strategies that encompass an ecosystem perspective and promote collaboration between competing interests. One strategy is to develop reserves where all harvest is prohibited. Reserves provide a precautionary measure against the possible impacts of an expanding human population and management uncertainties, offer education and research opportunities, and provide reference areas to measure non-harvesting impacts.

The proposed project also attempts to address the MRWG's consensus based goals and objectives, which were developed in response to the Problem Statement. The MRWG's goals stated the following:

> Ecosystem Biodiversity Goal: To protect representative and unique marine habitats, ecological processes, and populations of interest.
>
> Socio-Economic Goal: To maintain long-term socioeconomic viability while minimizing short-term socioeconomic losses to all users and dependent parties.
>
> Sustainable Fisheries Goal: To achieve sustainable fisheries by integrating marine reserves into fisheries management.
>
> Natural and Cultural Heritage Goal: To maintain areas for visitor, spiritual, and recreational opportunities which include cultural and ecological features and their associated values.
>
> Education Goal: To foster stewardship of the marine environment by providing educational opportunities to increase awareness and encourage responsible use of resources.

Subsequent to the formation of the MRWG, the State Legislature passed the Marine Life Protection Act (Chap. 1015, Stats. 1999) (MLPA). Language and intent in both the MLPA and the Marine Life Management Act (Chap. 1052, Stats. 1998) (MLMA) support the concept of ecosystem management. The MLPA requires that the Commission adopt a Marine Life Protection Program that in part contains an improved marine reserve component [Fish and Game Code Section 2853 (c)(1)] and protects the natural diversity of marine life and the structure, function, and integrity of marine ecosystems [Fish and Game Code Section 2853 (b)(1)]. The MLMA specifically states that long term resource health shall not be sacrificed for short term benefits, and that habitat should be maintained, restored, and enhanced [Fish and Game Code Sections 7056 (a) and (b)]. This protection may help provide sustainable resources as well as enhance functioning ecosystems that provide benefits to both consumptive and non-consumptive user groups. The proposed project attempts to meet these objectives.

The proposed project is intended to meet the following goals described in the Marine Life Protection Act [Fish and Game Code Section 2853(b)]:

(1) To protect the natural diversity and abundance of marine life, and the structure, function, and integrity of marine ecosystems.
(2) To help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted.
(3) To improve recreational, educational, and study opportunities provided by marine ecosystems that are subject to minimal human disturbance, and to manage these uses in a manner consistent with protecting biodiversity.
(4) To protect marine natural heritage, including protection of representative and unique marine life habitats in California waters for their intrinsic value.
(5) To ensure that California's MPAs have clearly defined objectives, effective management measures, and adequate enforcement, and are based on sound scientific guidelines.
(6) To ensure that the State's MPAs are designed and managed, to the extent possible, as a network.

In addition, California Coastal Act requires the protection of marine and biological resources (Public Resources Code Section 30230). Section 30230 provides that:

> Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.

1.4 Marine Protected Areas

No-Take Marine Protected areas, or marine reserves, are important tools for marine conservation and fisheries management, with the potential to provide ecosystem protection, improved fisheries yields, expanded understanding of marine environments, and improved non-consumptive opportunities. The degree to which a reserve will provide certain benefits or achieve specific goals will vary with the species, depending on life-history characteristics and various aspects of reserve design.

The number of documented successful examples of no-take marine reserves is increasing rapidly. There is now abundant evidence to show that within areas protected from fishing, rapid increases in abundance, size, biomass, and diversity of animals, occurs regardless of where in the world reserves are sited. Halpern (in press) reviewed 76 studies of reserves that were protected from at least one form of fishing. He derived aggregate measures of reserve performance, by combining responses of all the organisms studied for each of four variables: abundance, total biomass, average body size, and species diversity. Across all reserves, abundance (measured as density) approximately doubled. After reserves were established biomass, or the weight of all organisms combined, increased 2.5 times that in fished areas. Average body size of organisms protected in marine reserves increased by approximately 30 percent. The increase in size contributes to greater reproductive potential. For example, a large female red snapper may produce the same number of eggs as 212 fish that are 2/3 the size. In addition to changes in biomass, abundance, size, and reproductive potential, the number of species present per sample increased by 30 percent. These results are generally seen within 3 to 5 years of reserve establishment, though can take longer or be less significant in areas that did not have heavy fishing pressure prior to establishment.

<u>Increasing reproductive output and recruitment of fished species</u>

Many studies demonstrate that marine reserves promote a rapid increase in biomass of commercially important fish species within their boundaries (Roberts and Hawkins 2000). In most marine reserve areas, biomass will double after three to five years of protection, although some species, particularly those that have been exploited intensively, can increase in biomass by orders of magnitude. For any given area, increased biomass of a species should result in a greater reproductive output. For example, it has been estimated that the reproductive output of Nassau groupers (*Epinephelus striatus*) in a reserve in Exuma Cay in the Bahamas is 6 times greater than that in fishing grounds (Sluka et al. 1997). In Puget Sound off the north-west US coast, such differences are even greater. The reproductive output of lingcod (*Ophiodon elongatus*) in a reserve has been estimated at twenty times greater than it is in fished areas; the reproductive output of the copper rockfish (*Sebastes caurinus*) is 100 times greater in reserve than in fished areas (Palsson and Pacunski 1995).

Bohnsack modeled egg production by red snapper in the Gulf of Mexico within and without a 20 percent network of reserve areas (CINMS 2001). He estimated that if 20 percent of the fishing grounds were closed, egg production would rise by 1200 percent due to the increased contribution from more older, larger fish which can produce many times more eggs per individual than smaller younger fish.

When two large reserve areas were established in 1994 on Georges Bank, stocks of scallops rebounded within four years and recruitment to adjacent fishing areas also increased (Murawski et al. 2000). In July 1998, total and harvestable scallop biomasses were 9 and 14 times denser, respectively, in closed than in adjacent open areas. Satellite tracking shows that scallop fisheries are now concentrated near reserves, and total landings are at 150 percent of 1994 levels.

The rate of recruitment in new reserves depends on the size of source populations, how close they are to reserves, and the ability of recruits to disperse from them. If animals that disperse only short distances are to repopulate, then other reserves must be close to the source populations. This is particularly important for many species that require high population densities to reproduce successfully. If traditional management measures do not maintain critical densities, or critical densities do not exist within or nearby reserves, these species will recover slowly, or possibly not at all. For example, despite a long-term closure to fishing, conch (*Strombus gigas*) populations in the Florida Keys have not rebounded (Roberts and Hawkins 2000).

Many questions about the effects of marine reserves on reproductive output and recruitment still remain unanswered. Part of the problem is that there are too few protected areas available for study and little research has been directed at the question of reproductive output and recruitment. Contributing to the problem, recruitment is an extremely variable process. Recruitment may vary by orders of magnitude from year to year making it extremely difficult to prove that any increases measured in fishing grounds are a result of nearby reserves.

<u>Spillover</u>

No-take marine reserve areas can be used to reverse population declines, help rebuild seriously depleted animal populations, and protect species that cannot tolerate heavy fishing. Recent scientific evidence indicates that reserves are not only powerful tools for conservation, but they can provide much needed support for fisheries. As the number and biomass of individuals increase within reserves, many species will move out of reserves into fishing grounds, enhancing stocks in fished areas through spillover.

The distances over which spillover is significant depends on the mobility of the species involved. Numerous tagging studies of fish and crustaceans demonstrate that these species have the potential to disperse sufficiently long distances to move out of reserves. For example, in South Africa, recreational game fish, the galjoen (*Coracinus capensis*), were tagged inside the De Hoop reserve and tag recoveries were monitored. Of 11,022 fish tagged, 1008 were recovered, and of these, 828 where recovered within 5 km of where they were released. The remaining 180 (18 percent) were recovered at least 25 km from where they were released, and the maximum distance that any fish traveled was 1040 km (Attwood and Bennett 1994).

The Soufriere Marine Management Area (SMMA) was created in 1995 alone the coast of the Caribbean island of Saint Lucia. It encompasses 11 km of coast and includes a network of five marine reserves that constitute about 35 percent of the coral reef fishing grounds. Combined biomass of five commercially important fish families tripled in reserves in 3 years. Biomass doubled in adjacent fishing areas, despite concentration of fishing efforts outside reserves (Roberts et al. 2001). Mean total catch for fishermen with large traps increased by 46 percent per trip whereas mean catch for fishermen with small traps increased by 90 percent per trip (Roberts et al. 2001). The total fishing effort remained stable over the course of the investigation.

Tagging studies in and around the Merritt Island National Wildlife Refuge in Florida, documented movements of red drum (*Sciaenops ocellatus*), spotted seatrout (*Cynoscion nebulosus*), black drum (*Pogonias cromis*), striped mullet (*Mugil cephalus*), common snook (*Centropomus undecimalis*), and sheepshead (*Archosargus probatocephalus*) from unfished to fished areas (Johnson et al. 1999).

If animals are moving out of reserves, then densities should be higher in areas close to reserve boundaries than far away. Ratikin and Kramer (1996) found this type of evidence for spillover in Barbados. In experimental trap fishing, they found highest catches and catch per unit effort inside the Barbados Marine Reserve. However, outside the reserve catches increased approaching the boundary from both the north and the south. Russ and Alcala (1996) found a gradual increase in densities of fish outside Apo Island reserve in the Philippines, but very close to its boundary. This effect only became apparent after the reserve had been protected for 9 years, suggesting that this time was required for critical densities accumulated inside the reserve.

McClanahan and Kaunda-Arara (1996) found a 110 percent enhancement of catch per unit effort in fishing grounds close to the Mombasa Marine National Park in Kenya. This may have been due to a combination of spillover from the reserve and recruitment enhancement.

In Sumilon Island, Alcala and Russ (1990) found that catch per unit effort and total catches decreased by half after reserve protection broke down, despite a larger area of fishing grounds becoming available. This suggests that the reserve may have supported the fishery through a combination of spillover and recruitment enhancement.

In 1994, areas around the Georges Bank (USA) were closed to dredge gear designed for sea scallops (*Placopecten magellanicus*) in order to reduce the amount of groundfish bycatch (particularly flounders). Between 1994 and 1998, scallop biomass increased 14-fold within the closed areas (Murawski et al. 2000). In July 1998, total and harvestable scallop biomasses were 9 and 14 times denser, respectively, in closed than in adjacent open areas. Satellite tracking now shows that scallop fisheries are now concentrated near reserves, and total landings are 150 percent of 1994 levels.

Single-species closures provide further evidence of spillover. Spiny lobster (*Panulirus argus*) are protected from fishing in their nursery ground in the Biscayne Bay Spiny Lobster Sanctuary. As they grow, the lobsters move to fishing grounds in the Florida Keys where they may be harvested by commercial trappers (Davis and Dodrill 1980). Closures for snow crab in Japan also led to higher catches nearby (Yamaski and Kuwahara 1990).

The most compelling evidence that spillover is significant can be found in changing patterns of fishing effort following reserve establishment. In places where there are well-respected reserves, "fishing the line" or fishing close to the reserve boundaries, becomes increasingly prevalent. There are growing numbers of examples of fishing the line in different places in the world. Recreational anglers were frequently observed fishing the edge of the Merritt Island National Wildlife Refuge in Florida (Johnson et al. 1999). Several world record fish were caught near the Merritt Island National Wildlife Refuge, including four red drum (*Sciaenops ocellatus*), one black drum (*Pogonias cromis*), and three spotted seatrout (*Cynoscion nebulosus*). Conch and lobster fishers in Belize preferentially fish close to the edge of the Hol Chan marine reserve (Polunin and Roberts 1993). In Spain, fishers report 50-85 percent higher catches close to the Tabarca marine reserve after 6 years of protection (Ramos-Espla and McNeill 1994). Fishing patterns show that spillover does happen and it does benefit local fishers.

While fishing the line may increase effort and density of vessels near reserves, population benefits still exist. This increased effort removes only the excess stock produced by the reserve. As long as the reserve is large enough to contain a standing stock of large breeding adults, they will continue to reproduce. In practice, as noted above, the overall catch and catch per-unit-effort increases compared to pre-reserve levels.

<u>Benefits and Costs of No-Take Marine Protected Areas</u>

There are two perspectives on identifying the benefits and costs of marine reserves. The first focuses on the ecological/biological benefits and costs. Sanchirico (2000) has provided a simple summary of these benefits and costs (Figure 1-2). These are issues for which the Science Panel for the Marine Reserves of the CINMS has summarized the literature supporting the ecological/biological benefits and costs. A key distinction is the closed areas themselves versus the areas outside the closed areas, and the linkages between the areas. As Sanchirico and Wilen (2001) have shown, the ecological/biological benefits and costs are contingent on socioeconomic behavioral responses. So even though socioeconomic benefits and costs are dependent on the ecological/biological benefits and costs, the ecological/biological benefits and costs are predicated on socioeconomic behavioral responses. The determination of final outcomes is dependent upon both how the natural environment and humans respond to the protection strategy.

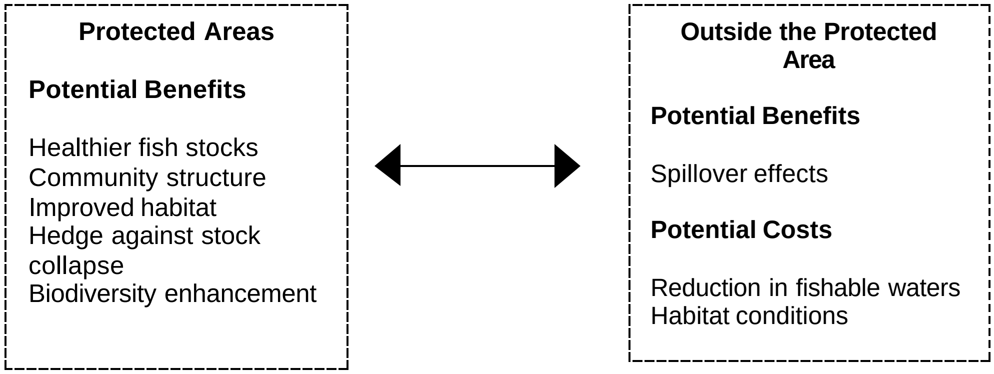

Figure 1-2. Potential Ecological/Biological Benefits and Costs of Marine Reserves. The boundaries of the two areas are drawn with dashed lines to symbolize the openness of the marine ecosystem. The link between the two areas is formally defined by the migration/dispersal patterns of fish stocks residing within and outside the protected areas along with the geographic or oceanographic characteristics of the marine environment. In general, fish migration patterns depend upon currents, temperatures, prevailing winds, and behavioral characteristics. The term "community structure" refers to the potential benefits in age/size structure of the fish stock and in trophic levels present in the protected area [From: Sanchirico (2000)].

The second perspective on benefits and costs of marine reserves is the socioeconomic benefits and costs. As stated above, they are both contingent on the ecological/biological benefits and costs and on socioeconomic behavioral responses. Below we list each potential benefit and cost along with each user group that would receive each benefit and/or cost and what measurement we would use to quantify or describe qualitatively the benefit and/or cost.

Potential Benefits

Environmental Ethics

Increasingly, society values the quality of the environment and recognizes that animals, plants, and habitats have some right to protection from human disturbance (NRC 2001). These “biocentric values”, valuing nature for its own sake, are important to many people’s views on how humans and nature should interact. When polled regarding the “environment-versus-economy” balance, more than 50 percent of people chose environmental protection over economic benefits (NRC 2001). Biocentric values, and the trends towards a desire for environmental protection, suggest that MPAs may be supported based on environmental ethics alone.

In addition, people value certain places and spaces that form a “cultural landscape” which links the physical environment and human values (NRC 2001). The theory of cultural landscapes includes (1) places (called landmarks), (2) spaces between places, and (3) a relational pattern that integrates space and place (NRC 2001). Places may contain archaeological artifacts, like shipwrecks, or may be culturally significant natural places. Marine areas can have significant cultural value beyond their pure economic value. MPAs can protect areas that provide for a cultural landscape that is maintained throughout time.

Non-consumptive Users (sport divers and wildlife viewers)

Since marine reserves will continue to allow non-consumptive activities, these user groups are potential beneficiaries. Over time it would be expected that the closed areas will increase in resource quality and there also may be reduced conflicts with consumptive users. This will attract additional non-consumptive users, which will increase demand for services and have impacts on the local economies. In addition, the resource quality increase would be expected to increase the net user value (Consumer's Surplus) per unit of use (measured as person-days). Consumer's Surplus or net user value by non-consumptive users is also sometimes referred to as non-market economic use value. Below is a list of potential benefits to non-consumptive users:

- Increased sales and income to businesses directly providing goods and services to non-consumptive users.
- Secondary increases in sales/output, income, jobs and tax revenues in the local economies (through economic multiplier impacts).
- Increase in Consumer's Surplus or net economic user value (non-market economic use value).

Nonusers or Passive Users

Economists have long recognized a special class of non-market economic values for natural resources and the environment referred to generally as nonuse or passive use economic value. These values are widely accepted as legitimate values to include in benefit-cost analyses of environmental regulations and in damage assessment cases. The term passive use, instead of nonuse, has become more popular because it is recognized that for people to have value for something they must have some knowledge about what they are valuing. People learn about natural resources or the environment they are asked to value through books, newspapers, magazines, newsletters, radio, television and other media sources. The people don't actually visit the sites and directly use the resources protected themselves, they use them passively through the many indirect sources. The values have been referred to in the literature as option value, bequest value and existence value to clarify people's underlying motives for their willingness to pay.

For non-consumptive users and passive users, the conditions of the ecosystem are important for determining the benefits of marine reserves. Marine reserves are known to change the status of the habitats protected and often result in changes in community structure and increase biodiversity. Also, one of the main benefits is the possibility of protecting a different functioning ecosystem (i.e., a more natural system with minimum influence by man). These may be conditions for which these user groups would be willing to pay for.

Commercial Fishing and Kelp Harvesting

Commercial fishing and kelp harvesting are displaced activities from marine reserves and so these user groups would be expected to suffer losses and can therefore be placed under potential costs. However, if marine reserves result in benefits to surrounding unprotected sites, i.e., increases in biomass and aggregate harvests, the commercial fishing industry will be a beneficiary. The benefits of marine reserves are usually stated as long-term benefits given the time frames necessary for habitats and fish stocks to improve. Below is a list of expected long-term benefits to commercial fishing:

- Long-term increases in harvest revenue and income to fishermen.
- Long-term increases in secondary output/sales, income, jobs and tax revenues in local economies. (through economic multiplier impacts).
- Long-term increases in Consumer's Surplus to consumers of commercial fishing products (if prices to consumers decline with increased harvests).
- Long-term increases in Economic Rents* (may or may not exist in open access fisheries). *Economic Rent is a return on an investment over and above a normal rate of return on investment. A normal rate of return on investment is that rate of return in which incentives are such that capital will neither outflow or inflow into the industry.

Recreational Fishing and Consumptive Diving

Just as with commercial fishing, recreational fishing and consumptive diving are displaced activities from marine reserves, and so these user groups would also be expected to suffer losses and therefore can be placed under potential costs. However, if marine reserves result in benefits to surrounding unprotected sites, i.e., increases in biomass and aggregate harvests, the recreational fishermen and consumptive divers, and supporting industries will be beneficiaries. The basis for these benefits is the potential increase in quality of the experience including the number and size of catch and possibly reduced conflicts with other users. The benefits of marine reserves are usually stated as long-term benefits given the time frames necessary for fish stocks to improve. Below is a list of expected long-term benefits to recreational fishing and consumptive diving:

- Long-term increases in sales and income to businesses that directly provide goods and services to recreational fishermen and consumptive divers.
- Long-term increases in secondary output/sales, income, jobs and tax revenues in local economies (through economic multiplier impacts).
- Long-term increase in Consumer's Surplus.
- Long-term increases in Economic Rent (may or may not exist in open access fishery).

Scientific and Education Values

Marine reserves provide a multitude of scientific and educational values. Sobel (1996) provides a list of these benefits. Scientific and education values were categorized by Sobel into those things reserves provide that increase knowledge and understanding of marine systems. Sobel provided the following list of benefits:

Scientific

- Provides long-term monitoring sites
- Provides focus for study
- Provides continuity of knowledge in undisturbed sites
- Provides opportunity to restore or maintain natural behaviors
- Reduces risk to long-term experiments
- Provides controlled natural areas for assessing anthropogenic impacts, including fishing and other impacts

Education

- Provides sites for enhanced primary and adult education
- Provides sites for high-level graduate education

Potential Costs

Trophic Cascades

It has been suggested that MPAs may alter the trophic structure within and near marine protected areas. Salomon et al. (2002) modeled the trophic effects of a variety of different zoning policies for marine protected areas within the proposed Gwaii Haanas National Marine Conservation Area. They used an ECOSPACE model which is a spatially explicit, ecosystem modeling tool that illustrates biomass dynamics in two-dimensional space over a grid (Walters et al. 1999). The model was constructed with 22 ecosystem components, including marine mammals, seabirds, fishes, invertebrates, plankton and detritus. Each component was described in terms of biomass, diet composition, consumption per biomass, and production per biomass ratios based on published data. These numbers represent "best guesses" of the actual parameters. Physical and transport processes and temporal variation in biomass, production, and diet were not represented in the model.

The model predicted a gradient in density at the edges of marine reserves due to the effects of edge fishing depleting populations that live near the boundaries of marine reserves.

The modeling effort (Salomon et al. 2002) demonstrates that large marine reserves provide greater protection than smaller reserves surrounded by a limited-take buffer zone. This illustrates that buffer zones can effectively reduce the size of the core "no-take" zone and therefore reduce the protection afforded to low-dispersing species. The ecological cost of reducing the "no-take" area to establish a buffer zone is greater than the ecological benefits of a reduction in edge effect due to the buffer.

Three small MPAs, in which the total surface area protected was equivalent to the single large MPA, resulted in smaller biomass of low-dispersing species (Salomon et al. 2002). Large MPAs minimize the edge effects, include more species and more populations, and can encompass species with larger dispersal patterns (Salomon et al. 2002).

Modeling limited take by aboriginal people in the core area reduced the ecological benefits of the MPA by causing a decline in lingcod, rockfish, shallow infauna and avian predators (Salomon et al. 2002). The ecological consequence of aboriginal fishing within the core "no-take" zone greatly reduces the benefits of the reserve for aboriginal and other fishermen.

Large-scale reduction in fishing pressure and establishment of a large MPA was the only policy that resulted in an increase in biomass of widely dispersing organisms such as pinnipeds, baleen and toothed whales, hake, pollock, and planktivorous fish (Salomon et al. 2002).

Salomon et al. (2002) cautioned that MPAs should not be judged as ineffective if high densities of organisms are not observed within their boundaries. The model suggests that trophic cascades are likely to occur in reserves as the biomass, abundance, and diversity of organisms increase (Salomon et al. 2002). An increase in top predators may result in the local depletion of particular prey species. However, an increase in predation on a competitive dominant species may cause a local increase in species diversity by reducing competition for resources or the grazing pressure of a herbivore.

Empirical studies suggest that trophic cascades may occur when areas are protected from fishing, particularly when top predators have been reduced in numbers (e.g. sea otters and California sheephead), allowing exceptional growth of prey populations (e.g. sea urchins). One consequence of reserve establishment may be to offset the exceptional growth of prey populations with increased numbers of top predators. In this circumstance, declines are expected and desired from the perspective of ecosystem management.

Although a few examples of trophic cascades in marine reserves have been documented in Kenya, Chile, and the Mediterranean (Castilla and Duran 1985; Duran and Castilla 1989; McClanahan and Muthiga 1988; McClanahan and Shafir 1990; Watson and Ormond 1994; McClanahan 1994, 1995, 1997; Sala et al. 1998a), evidence from over 80 marine reserves in temperate and tropical waters suggests that populations at all trophic levels of the food web benefit from protection in reserves (Halpern, in press). For carnivorous fishes, 66 percent of reserves had higher density, 84 percent of reserves had higher biomass, 83 percent of reserves had larger organisms, and 74 percent of reserves had higher diversity (Halpern, in press). If trophic cascades impacted communities in marine reserves, then one would expect an increase in carnivorous fishes, and a decrease in planktivorous fishes and invertebrates consumed by those predators. However, this effect is not demonstrated for over the majority of communities studied in existing marine reserve areas. In contrast, planktivorous fish and invertebrate populations increase proportionally with populations of carnivorous fishes. For planktivorous fishes and those that consume invertebrates, 62 percent of reserves had higher density, 55 percent of reserves had higher biomass, 55 percent of reserves had higher diversity, and 89 percent of reserves had larger organisms (Halpern, in press). For herbivorous fishes, 53 percent of reserves had higher density and 63 percent of reserves had higher biomass (Halpern, in press). For invertebrates, 50 percent of the reserves had higher density and 83 percent of the reserves had larger organisms (Halpern, in press). The relative impact of reserves on all biological measures in each functional group was significantly positive. Thus, marine reserves are unlikely to perpetrate radical changes in trophic structure unless the system already is highly disturbed (with exaggerated growth of low to mid-trophic level species and severely reduced populations of mid-trophic level or top predators).

Commercial Fishing and Kelp Harvesting

As mentioned above, commercial fishing is one of the displaced activities from marine reserves. Sanchirico and Wilen (2001) discuss the ecological/biological and socioeconomic conditions under which commercial fisheries might benefit or suffer costs from marine reserves. There are sets of conditions under which they predict would result in short-term and/or long-term costs.

- Lost harvest revenue and income to fishermen.
- Secondary losses in output/sales, income, jobs and tax revenues in local economies (through economic multiplier process).
- No loss in harvest but increased cost of harvesting resulting in lost income to fishermen.
- Losses in Consumer's Surplus to consumers of commercial seafood products (if prices rise for fishery products due to reductions in harvests).
- Overcrowding, user conflicts, possible overfishing or habitat destruction in remaining open areas due to displacement. This could raise costs and/or lower harvests.
- Displacement may result in loss of harvest knowledge that may support sustainable fishing practices.
- Social disruptions from losses in incomes and jobs.

Whether any of the above costs are short-term or long-term depends greatly on the off-site impacts of the protected areas as listed in Figure 1-2, but also on the status of the fish stocks with fishery management regulations (are current harvest levels sustainable?), and the behavioral responses and economic conditions of the fishing industry. It is not always true that there will even be short-term losses (Leeworthy and Wiley 2001).

Recreational Fishing and Consumptive Diving

As mentioned above, recreational fishing and consumptive diving would be displaced from marine reserves. Sanchirico and Wilen (2001) discuss the ecological/biological and socioeconomic conditions under which these user groups might benefit or suffer costs from marine reserves. There are sets of conditions under which they predict would result in short-term and/or long-term costs.

- Lost sales revenue and income to businesses that directly provide goods and services to recreational fishermen and consumptive divers.
- Secondary losses in output/sales, income, jobs and tax revenues in local economies (through economic multiplier impacts).
- Losses in Consumer's Surplus (if consumptive users are forced to substitute to less valued locations or if they are crowded into remaining open areas where they experience congestion effects or if it costs more to relocate to other areas).
- Losses in Economic Rent (may or may not exist in open access environment).

As with commercial fisheries, whether any of the above costs are short-term or long-term depends greatly on the off-site impacts of the protected areas as listed in Figure 1-2, but also status of the fish stocks under fishery management regulations (are current harvest levels sustainable?), and on the behavioral responses and economic conditions of the consumptive recreational industry. It is not always true that there will even be short-term losses if there are adequate substitute sites.

Ports and Harbors

Those involved in managing ports and harbors have expressed concern with respect to the issue that if marine reserves in the Sanctuary result in decreases in business volume they may have a negative impact on ports and harbors. The concern goes beyond the impacts described above and is focused on the issue of how the Federal government (the U.S. Army Corps of Engineers and Congress) make decisions about funding for dredging to maintain ports and harbors. The economic impact estimates do provide some details on ports and harbors and can be used to assess these indirect effects. As with the above, there might be short-term gains and losses in business volume (gains to non-consumptive users and losses to consumptive users) and there might be long-term gains for all users. Thus, there is a possibility of both benefits and costs to ports and harbors.

1.5 Conclusion

The Department feels that a network of Marine Protected Areas in State waters in the Sanctuary will best help address the issues raised during the Channel Islands MRWG process. The proposed project is intended to respond to the MRWG Problem Statement and attempts to address the MRWG goals and objectives for MPAs. The proposed project also attempts to address the goals and requirements of the Marine Life Protection Act within the Channel Islands region.

The nature of Marine Protected Areas helps ensure that at least a portion of populations in the project area will be sustained over time. Because of Marine Protected Areas' protective nature and potential to enhance marine ecosystems along with changes to existing management in the area of the proposed project and recent and proposed changes to existing management measures in other concurrent projects (such as the Nearshore Fisheries Management Plan), the proposed project is not only expected to have no adverse impacts on the State's marine resources and ecosystems, but will ultimately result in positive net impacts.

The following chapters describe the proposed project and alternatives in detail. Chapter 2 contains background information on the Environmental Document and public process. Chapter 3 contains the description of the proposed project and each alternative. Chapter 4 describes the environmental settings of the project area. This includes descriptions of the physical environment, biological environment, and human environment. Chapter 5 describes the potential environmental impacts of the proposed project. Chapter 6 describes the potential environmental impacts of each alternative to the proposed project. Chapter 7 describes consultation undertaken with other agencies prior to and during development of the proposed project.